Siricid Woodwasps and Their Associated Parasitoids in the Southwestern United States

(Hymenoptera: Siricidae)

A. A. Kirk

CSIRO Division of Entomology, P.O. Box 1700, Canberra City, A.C.T., Australia[1]

Since 1962 the Division of Entomology, CSIRO, has been involved in the biological control of *Sirex noctilio* F which was accidentally introduced into and has become established in plantations of *Pinus radiata* D. Don in southeastern Australia. Insect parasitoids and parasitic nematodes of siricids have been collected in the northern hemisphere and consigned to Tasmania for culturing and subsequent release in infested areas of Tasmania and Victoria. Earlier collecting in North America has been confined to California and Nevada and eastern Canada (Taylor 1967; Lloyd 1968, 1970). Ten species of siricids and six species of hymenopterous parasitoids were known to be present in Arizona, Colorado, and New Mexico (Cameron 1965), the three states I surveyed in 1971.

During April to August 1971 dead or dying coniferous trees and associated branches, logs and stumps were examined for signs of siricid larvae or galleries. Infested material was cut into one metre lengths and transported to outdoor cages at Flagstaff, Arizona. The logs were separated into groups according to locality and tree species. With limited time available the main emphasis of the work was placed on obtaining exact identifications of trees and the insects emerging from them. Precise daily records were made of insect emergence and from these their flight periods were determined. Insects were reared from 11 localities in northern Arizona, 2 localities in New Mexico, and from the San Juan Mountains in Colorado.

Results

The siricids *Sirex cyaneus* F., *S. juvencus californicus* (Ashmead), *S. longicauda* Middlekauff, *Urocerus californicus* Norton, *U. gigas* L., *Xeris morrisoni morrisoni* Cresson and *X. spectrum* L. were reared from *Abies concolor* (Gord. & Glend) Lindl, *A. lasiocarpa* (Hook) Nutt, *Picea engelmanni* Parry and *Pinus ponderosa* Laws. (Table 1).

[1] Present address: CSIRO Biological Control Unit, 335 Ave Abbé Paul Parguel, 34000—Montpellier, France.

TABLE 1. Insect emergence from stored material.

Host Tree	No. of Logs	Mean Diam. (cm.)	Sir.c	S.j.c.	S.l	U.c.	U.g	X.m	X.s	R.h	R.p	M.n	Sch.c	I.l.e	I.m	I.rc	I.rp	P.m
P. ponderosa	54	9.3	—	—	—	—	—	—	x	x	—	—	x	—	—	—	—	—
Pa. engelmanni	8	28.0	—	—	—	—	—	—	x	—	x	—	—	—	—	—	—	x[a]
A. lasiocarpa / *A. concolor*	14	41.0	x[a]	—	—	—	—	—	x	—	x[a]	—	—	—	—	—	x[b]	x
P. ponderosa	19	9.1	—	—	—	—	—	—	x	—	x	—	—	—	—	—	—	—
P. ponderosa	23	9.5	—	—	—	—	—	—	x	x	x	x	x	—	—	—	—	—
A. concolor	13	28.1	x[b]	—	x	x[a]	—	x[a]	—	—	x[b]	x	x	—	—	—	x[b]	—
P. ponderosa	76	12.4	—	x[a]	—	—	—	—	x[a]	x	x[b]	x[a]	x[a]	—	—	x	x[b]	—
Pa. engelmanni	17	27.4	x[a]	—	—	—	—	—	x[a]	—	x[b]	x	—	x	—	—	—	—
A. concolor	6	15.3	—	—	—	x	—	x[a]	—	—	x	x	—	—	—	—	—	x
A. concolor	4	27.4	x[a]	—	—	—	x[a]	—	x	—	x[a]	—	—	—	—	—	x[b]	—
P. ponderosa	4	9.3	—	x[a]	—	—	—	—	—	—	—	—	—	—	—	—	—	—
P. ponderosa	23	7.4	—	—	—	—	—	—	x	x	—	—	x	—	—	—	—	—
A. concolor	14	16.7	—	—	x	x	—	x	—	—	x[a]	—	x	—	x[a]	—	—	—
A. concolor	48	26.0	x[a]	—	—	—	—	—	x[a]	—	x[a]	x[b]	—	—	—	—	x[b]	—
EMERGED 1971			347	186	106	41	11	113	150	161	111	64	358	10	43	210	—	10
EMERGED 1972			106	51	—	2	2	10	148	—	198	79	41	—	4	—	115	10

[a] Part emerged 1972.
[b] All emerged 1972.

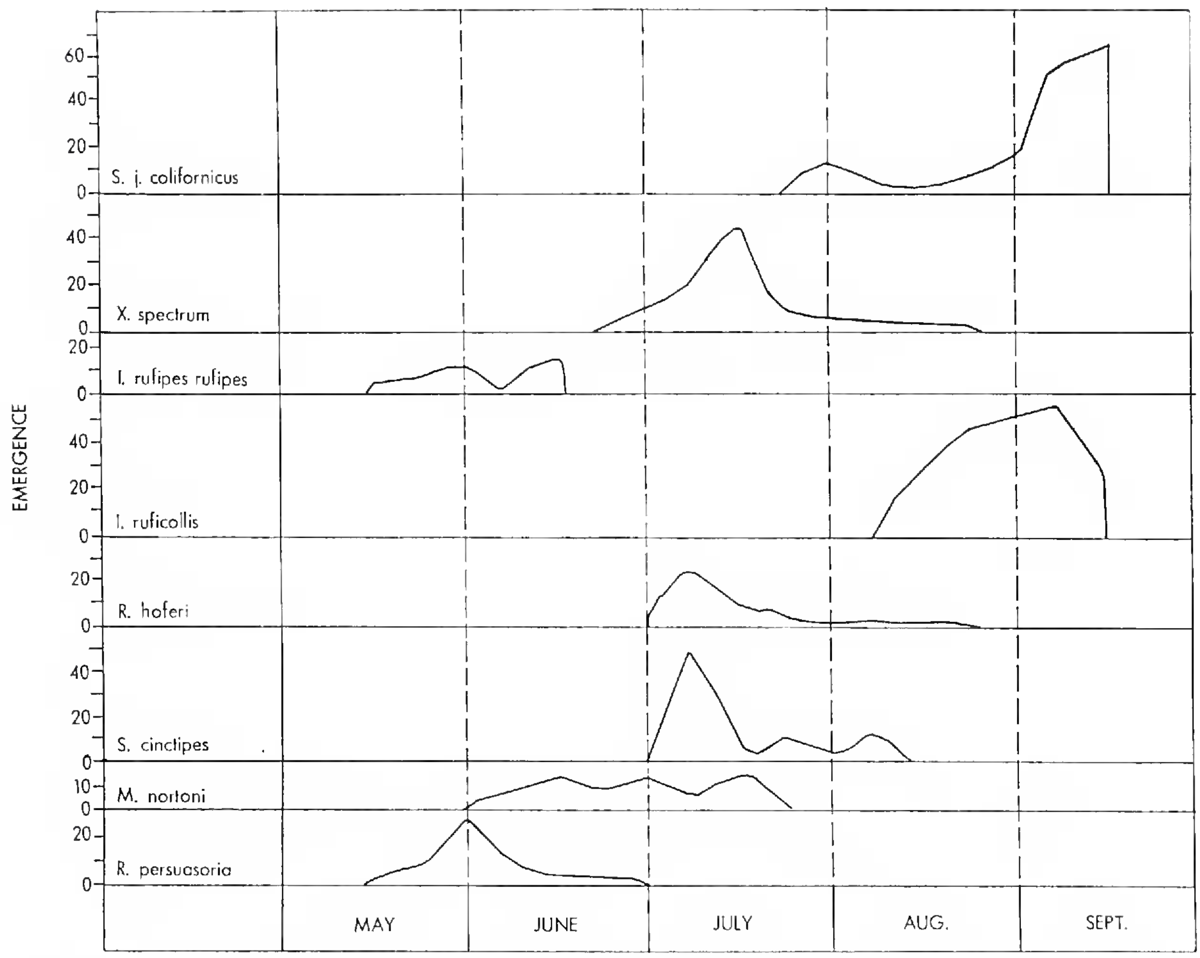

Fig. 1. Seasonal emergence of siricids and associated parasitoids from logs collected at Happy Jack, Arizona.

Nine species which are known to be parasitoids also emerged. These were the ichneumonids *Rhyssa alaskensis* Ashmead, *R. hoferi* Rohwer, *R. persuasoria* L. and *Megarhyssa nortoni nortoni* Cresson; the ibaliids *Ibalia leucospoides ensiger* Norton, *I. montana* Cresson, *I. ruficollis* Cameron and *I. rufipes rufipes* Cresson; and the stephanid *Schlettererius cinctipes* (Cresson) (Table 1). The cleptoparasite *Pseudorhyssa maculicoxis* (Kreich) was found associated with *R. persuasoria* at three localities in Arizona (Table 1). The timber was stored over the winter of 1971/72 and another 766 insects emerged during 1972 (Table 1). More than 50% of the insects which emerged were parasitoids, but this cannot be taken as a true figure for parasitism because insect emergence had already taken place from some of the material collected.

Discussion

Rather homeostatic conditions prevail in many of the undisturbed western United States coniferous forests (Hagen *et al.*, 1971), and epidemic outbreaks of insects are relatively rare (Balch, 1960). No evidence was found of current siricid epidemic outbreaks during the

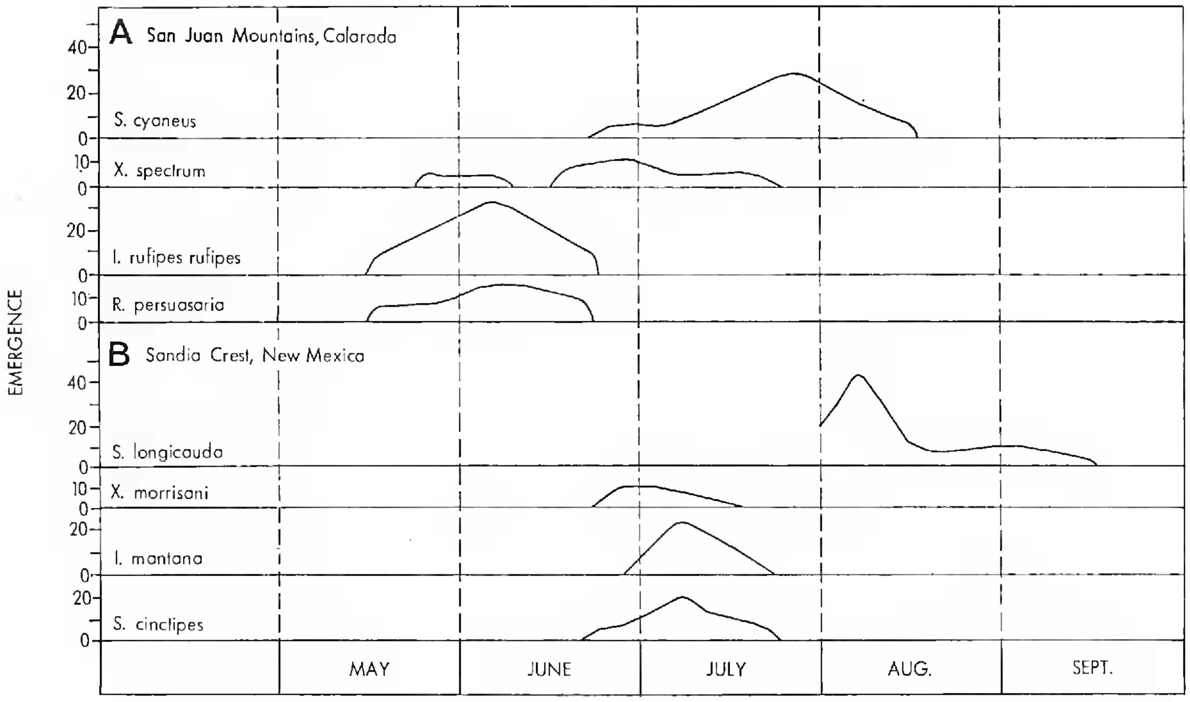

FIG. 2. Seasonal emergence of siricids and associated parasitoids from logs collected at A. San Juan Mountains, Colorado; B. Sandia Crest, New Mexico.

survey. The coniferous forests of the southwestern United States appear to be very diverse and stable communities, therefore it seems likely that host specific associations between insects and trees would have evolved. Evidence that seems to substantiate this is that *S. juvencus californicus* was associated only with *Pinus* spp. and *S. longicauda, U. californicus* and *X. morrisoni* were associated only with *Abies* spp. (Table 1). Less specialized relationships were found with *S. cyaneus*, which emerged from both *Abies* and *Picea*, and *X. spectrum*, which emerged from these as well as *Pinus* (Table 1). In addition Spradbery and Kirk (unpublished data), after eight years of extensive survey work and intensive collecting of siricid infested material and subsequent meticulous rearing, have evidence that there are distinct siricid coniferous tree associations in Europe and neighbouring areas. While the apparent siricid host tree associations in the southwestern United States described above cannot be regarded as conclusive without further data, there are good reasons for thinking that they are firm associations.

R. hoferi and *I. ruficollis* only emerged from *Pinus* (Table 1) and may be associated with *S. juvencus californicus*. *R. persuasoria, M. nortoni nortoni* and *S. cinctipes* attacked a wider range of siricid species from different host tree species (Table 1).

Relationships between siricids and parasitoids are clearly seen when the flight periods of the three ibaliid species are examined. *I. rufipes*

rufipes and *I. montana* have early summer flight periods and could only attack overwintered siricid larvae (Figs. 1, 2). The closely related *I. rufipes drewseni* Borries in Europe (Kerrich, 1973) behaves in the same way (Spradbery, 1970). *I. ruficollis* has an early autumn flight period and was observed to attack *S. juvencus californicus* larvae late in September. The closely related *I. leucospoides leucospoides* (Hochenwarth), (Kerrich, 1973), from Europe and neighbouring areas also attacks siricids in autumn, active females being noted in Tunisia as late as November (Spradbery and Kirk, unpublished data).

Much further work needs to be done to clarify the role of parasitoids in the suppression of siricid populations in the southwestern United States, but present evidence indicates considerable importance.

ACKNOWLEDGEMENTS

I wish to thank the Director of the U.S. Forestry Service for permission to collect infested timber, Forestry Service personnel for technical assistance, Dr. J. R. Wick, Chairman, Department of Biological Sciences, Northern Arizona University, Flagstaff, for providing laboratory facilities, Dr. C. D. Johnson for help with the manuscript, Mrs. Frances B. McAlister for permission to site cages on her land and Mr. T. D. Center for invaluable assistance during the survey. Funds for the project were provided by the National Sirex Fund, Australia.

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